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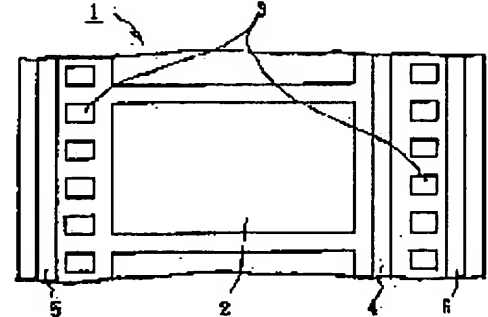
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(54) MOTION PICTURE FILM AND ITS RECORDING METHOD

(57)Abstract:

PURPOSE: To execute high density recording without deteriorating a signal to the limit of the resolving power of film by providing a digital sound track where digital sound data is optically two-dimensionally recorded as the data which does not include an isolated pit.

CONSTITUTION: The digital sound data in 8-bit units obtained by digitizing an analog sound signal is two-dimensionally recorded on the digital sound track 5(6) as the pit pattern of $4 \times 3 = 12$ bits which does not include the isolated pit by 8-12 modulation. The shortest repeat lengthwise or breadthwise is equal to or above 2 pits, and the digital sound data is two-dimensionally recorded on the track 5(6) of motion picture film 1 as the pit pattern whose lengthwise and breadthwise four directions are not surrounded by other kinds of pits, so that any of up, down, right and left pits becomes the same kind. Therefore, the film 1 is hardly deteriorated by diffraction at the time of recording and the diffusion of particles at the time of developing.



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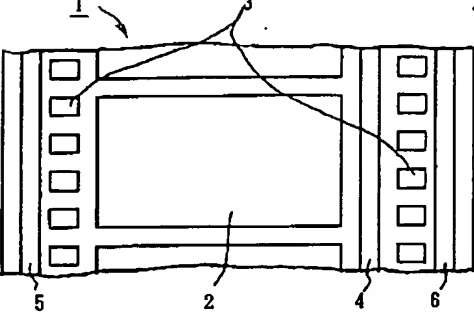
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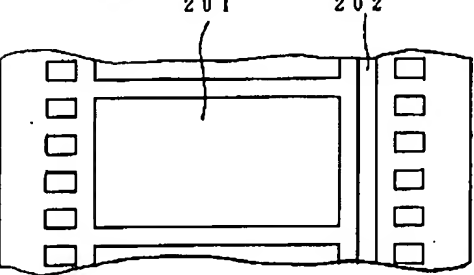
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DRAWINGS

[Drawing 1]



[Drawing 5]



[Drawing 2]

{ {a, b, c, d}, {e, f, j, h}, {e, f, j, h} }

(A)

a	b	c	d
e	f	g	h
i	j	k	l

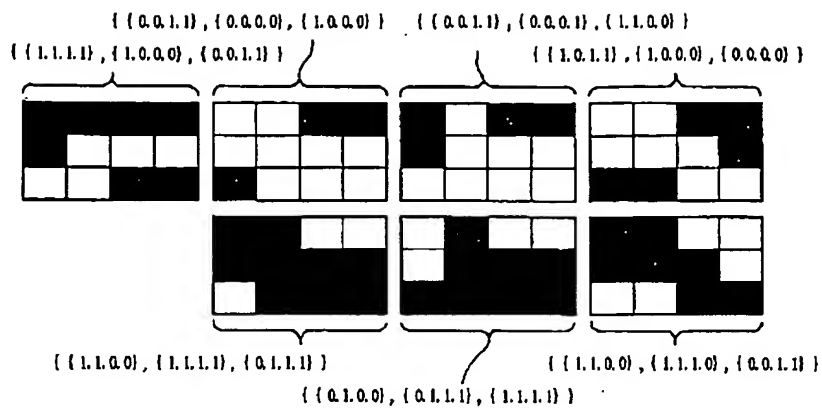
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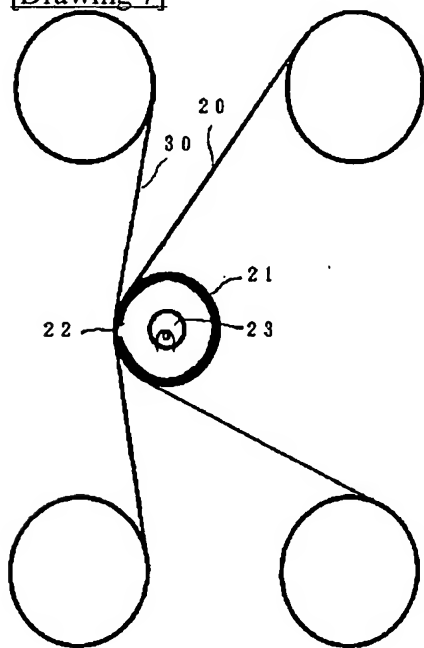
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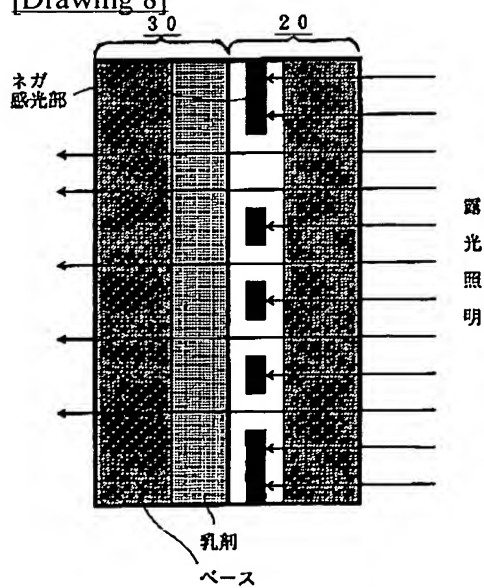
[Drawing 3]



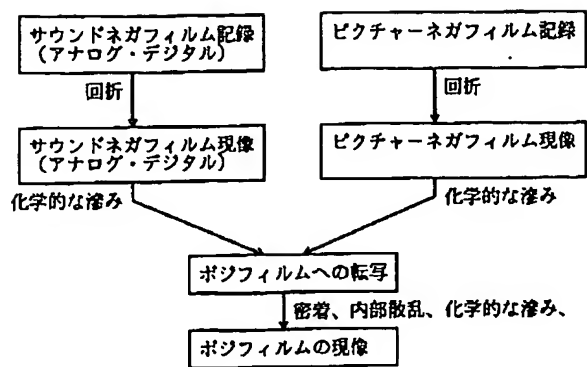
[Drawing 7]



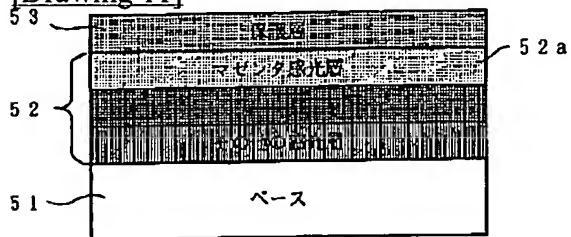
[Drawing 8]



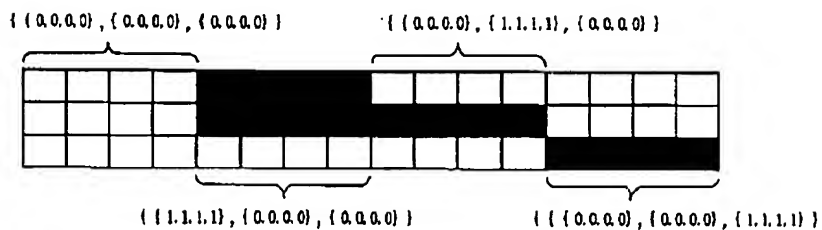
[Drawing 9]



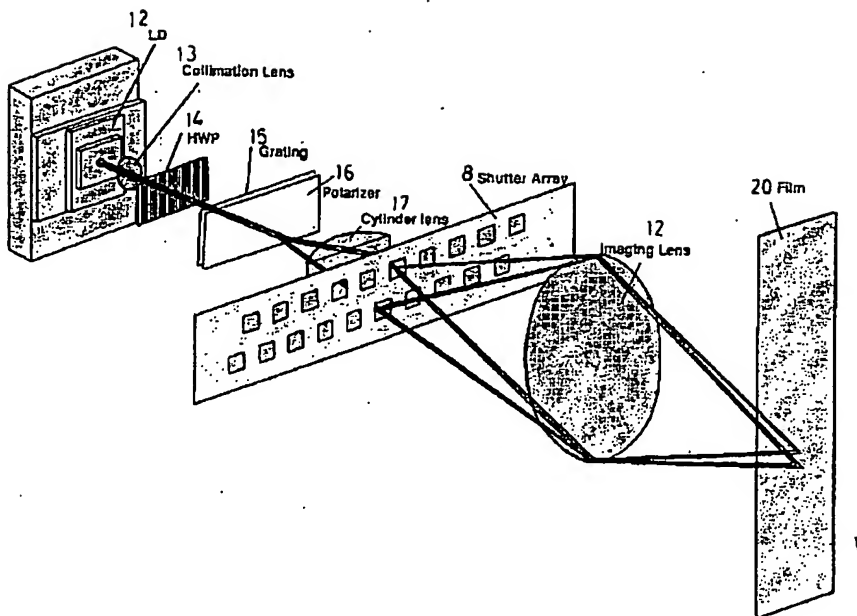
[Drawing 11]



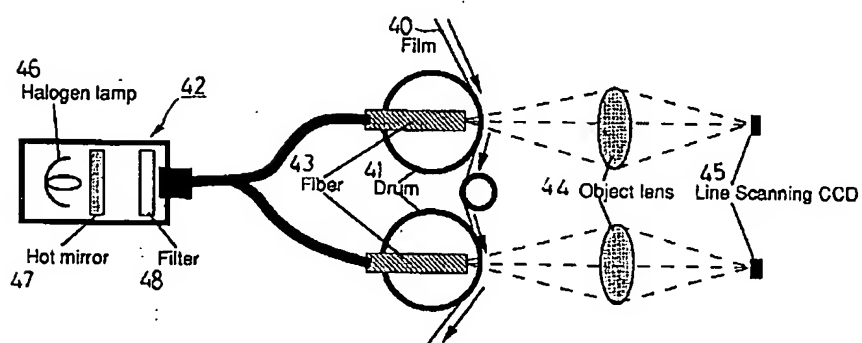
[Drawing 4]



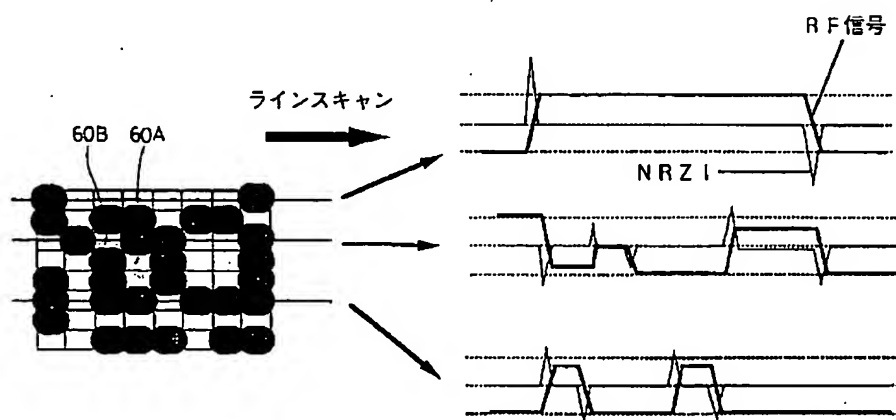
[Drawing 6]



[Drawing 10]



[Drawing 12]



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the motion-picture film with which two-dimensional record of the digitized voice data was carried out optically, and its record approach.

[0002]

[Description of the Prior Art] In the conventional motion-picture film, as shown in drawing 5, the sound signal was recorded on one analog voice track 202 established in 1 side of the image recording field 201 where an image is recorded along the film transit direction.

[0003] Moreover, the various attempts in which the field for digitized voice tracks will be established in the intact field of a current format are made, leaving this present format, in order to enable it to obtain the sound reproduction output which was rich in presence on the occasion of projection. This applicant has proposed previously the technique which made possible sound reproduction which was rich in presence as established two digitized voice tracks in both the outsides of the image recording field where the image of a motion-picture film is recorded along the film transit direction and carried out the digital storage of the digitized voice signal to these digitized voice tracks (Japanese Patent Application No. No. 222342 [three to], Japanese Patent Application No. No. 265001 [three to], Japanese Patent Application No. No. 320918 [four to]).

[0004] In the digitized voice track of a motion-picture film, two-dimensional record of the digitized voice data is optically carried out by the recording apparatus which consists of a laser light source 10 and the space modulator 11 as shown in drawing 6, an image formation lens 12, etc.

[0005] In the recording device shown in drawing 6, the above-mentioned space modulator 11 comes to have the optical modulator 18 into which the laser beam from the above-mentioned laser light source 10 which consists of semiconductor laser is inputted through a collimator lens 13, 1/2 wavelength plate 14, the diffraction-grating plate 15, a polarizing plate 16, and a cylindrical lens 17.

[0006] The above-mentioned optical modulator 18 has a total of the opening line of two lines of 1st opening line 18A which comes to allot opening 18a of the number of predetermined pits on 1 train, and 2nd opening line 18B which similarly comes to allot opening 18b of the number of predetermined pits on 1 train. And as each openings 18a and 18b of the above 1st and the 2nd opening line 18A and 18B vacate spacing for one opening (gap section) between opening and the next opening, they are prepared in it, respectively. Moreover, just under each gap section of opening line 18A of the above 1st, each opening 18b of opening line 18B of the above 2nd is located. That is, each opening 18a of opening line 18A of the above 1st and each opening 18b of 2nd opening line 18B are allotted alternately.

[0007] The laser beam by which outgoing radiation is carried out from the above-mentioned laser light source 10 is made into parallel light by the above-mentioned collimator lens 13, and incidence is carried out to the above-mentioned diffraction-grating plate 15 through the 1/2 above-mentioned wavelength plate 14.

[0008] Moreover, the above-mentioned diffraction-grating plate 16 is adjusted so that the outgoing radiation of the primary diffracted light may become the strongest, from the laser beam by which incidence was carried out through the 1/2 above-mentioned wavelength plate 14, forms the 1st laser beam and 2nd laser beam which are the primary [**] diffracted light, and carries out incidence of these to the above-mentioned cylindrical lens 17 through a polarizing plate 16.

[0009] Furthermore, the above-mentioned cylindrical lens 17 changes and carries out outgoing radiation of the optical path of this 1st and 2nd laser beam so that incidence of the 1st and 2nd laser beam of the above may be carried out to the 1st of the above-mentioned optical modulator 18, and the 2nd opening line 18A and 18B by

the small incident angle, respectively.

[0010] The above-mentioned optical modulator 18 changes electric voice data into the signal of spatial optical reinforcement using the electro-optical effect, changes the phase of the laser beam which penetrates each openings 18a and 18b of each opening lines 18A and 18B according to voice data, and modulates the reinforcement of this laser beam. Moreover, the above-mentioned optical modulator 18 drives the above 1st and the 2nd opening line 18A and 18B by predetermined time difference according to the above-mentioned voice data. By this, the 1st laser beam of the above and the 2nd laser beam will set the above-mentioned predetermined time amount, and outgoing radiation will be carried out by turns. The 1st and 2nd laser beam of the above made into the signal of this optical reinforcement is [0011] irradiated by the digitized voice track of a motion-picture film 20 through the above-mentioned image formation lens 12. and in the digitized voice track of the above-mentioned motion-picture film 20 rolled round by running at the rate of predetermined The 1st and 2nd modulated laser beam by which outgoing radiation is carried out by turns through each openings 18a and 18b to which the above-mentioned optical modulator 18 was allotted alternately is irradiated. By irradiating the 2nd laser beam of the above on the same rank of the voice data recorded by irradiating the 1st laser beam of the above Between the pit patterns of the voice data based on the 1st laser beam through each opening 18a of opening line 18A of the above 1st In the form where the pit pattern of the voice data based on the 2nd laser beam through each opening 18b of opening line 18B of the above 2nd is stuffed, voice data is recorded on the digitized voice track of the above-mentioned motion-picture film 20 as a pit pattern. Thereby, pit patterns do not lap and the pit pattern of voice data by the 1st laser beam of the above and the pit pattern of the voice data based on the 2nd laser beam are recorded in the vertical direction without a clearance to the film transit direction, even if the 1st and 2nd laser beam is irradiated on the same rank.

[0012] Thus, after developing the negative film 20 for digitized voice sound recording with which two-dimensional record of the voice data was carried out on the digitized voice track, as shown in drawing 7 , by the printer head 21 for an imprint, to a positive film 30, adhesion exposure is carried out and it imprints. The printer head 21 imprints the above-mentioned negative film 20 to a positive film 30 by irradiating the above-mentioned illumination light through the above-mentioned negative film 30 at the positive film 30 put on the negative film 20, as it has the light source 23 which carries out outgoing radiation of the illumination light through a slit 22 and is shown in drawing 8 .

[0013] Moreover, as a picture and analog voice are also shown in drawing 9 , a negative film is imprinted by the positive film through the same process. And a picture, a digitized voice signal, and an analog sound signal are recorded on the final positive film for a show.

[0014] Thus, the pit pattern of voice data is optically read in the above-mentioned digitized voice track with a regenerative apparatus as shows the made motion-picture film to drawing 10 .

[0015] In the regenerative apparatus of this motion-picture film, the illumination light led to the drum 41 through the optical fiber 43 from light equipment 42 on the digitized voice track of the motion-picture film 40 which carries out slide contact transit is irradiated, and the pit pattern of voice data is read for every horizontal single tier with the above-mentioned CCD line sensor 45 by projecting the pit pattern on the above-mentioned digitized voice track on the pixel of the CCD line sensor 45 through an objective lens 44. It comes to provide the hot mirror 47 for cutting a halogen lamp 46, a heat ray, and infrared radiation into the above-mentioned light equipment 42, and the high-pass filter 48 for an S/N improvement.

[0016] The light outputted from the above-mentioned light equipment 42 is divided into a 2-way through an optical fiber 43, and this is irradiated by the both sides of a DEJITARUSA voice track arranged on the right and left on a film.

[0017] In addition, as the positive film for films has shown the fundamental cross-section structure to drawing 11 , an emulsion layer 52 is formed on the base 51, and the protective layer 53 is formed on it. In the positive film of a color, many sensitization layers put as an emulsion layer, and a ***** cage and its each class have sensibility in the wavelength band. And when imprinting from a negative film to MOJIFIRUMU, in order to suppress the magnitude of a particle, internal diffraction, and dispersion, when admiration agent layer 52a in the light of the wavelength band of the sensibility which the sensitization layer which exists on the top has, for example, the top, is the layer of a Magenta, it is made to imprint using the light of a Magenta.

[0018]

[Problem(s) to be Solved by the Invention] By the way, producing a blot in the development / imprint process is known for the motion-picture film like before, and the part of the edge of the pit of a digitized voice track flags.

This originates in the diffraction at the time of record, diffusion of the particle at the time of negative film development, dispersion between the degree of adhesion at the time of an imprint, and each class inside a film, diffusion of the particle at the time of positive film development, etc. And who of an edge becomes a failure at differential detection of an edge. Moreover, since who of an edge appears as instability of amplitude degradation of a differential signal and the location of an edge, he causes a jitter.

[0019] If magnitude of a pit is made small in order for the method which carries out two-dimensional record of the voice data optically to raise recording density, as shown in drawing 12, the most remarkable effect will appear the methods of four in the isolated pits 60A and 60B surrounded in the pit of reverse. That is, they are unexposed pit 60A which had the methods of four surrounded in the exposed pit, and the exposure pit which had the methods of four surrounded by unexposed pit 60B.

[0020] A central isolated pit will corrode "Also by which case case, it is a stain from a perimeter and be alike." Since exposure and development are performed in a negative and a positive, respectively, it can say that this is the same about both an exposure isolated pit and an unexposed isolated pit. That is, thing signal degradation surrounded in the pit of the class of others [method / of perimeter 4] compared with that the method of perimeter 3, the method of two, and whose method of one are the pits of other classes had the trouble of being remarkable.

[0021] Although the same problem had arisen also in record of the conventional analog voice truck, a negative film is exposed strength, the imprint to a positive film is weakened, and he manages the reinforcement, and was trying to take out the optimal conditions. however -- record of a digital signal -- recording density or -- since it is high, this condition will become very severe. Moreover, it is necessary to correspond the condition about various cases. Margin management of this film exposure spoils system-wide stability, and makes the specification of other parts still severer.

[0022] Then, the object of this invention is to offer the motion-picture film which cannot receive degradation in the process resulting from the diffraction at the time of record, diffusion of the particle at the time of negative film development, dispersion between the degree of adhesion at the time of an imprint, and each class inside a film, diffusion of the particle at the time of positive film development, etc. easily in view of the conventional trouble like ****.

[0023] It is in offering the record approach of a motion-picture film that high density record can be performed to the limit of resolution of a film.

[0024] It is in providing the digitized voice truck in alignment with the longitudinal direction of a motion-picture film with the record approach of the motion-picture film which can carry out two-dimensional record of the digitized voice data excluding an isolated pit.

[0025] It is in shortening the die length of the continuation pit where the same pit as the longitudinal direction of a motion-picture film continues, and offering the record approach of the motion-picture film which can regulate the longest repeat.

[0026]

[Means for Solving the Problem] The motion-picture film concerning the 1st invention is characterized by having the digitized voice truck by which two-dimensional record was optically carried out as N bit data of the two-dimensional array of $N=mxn$ with which a M-N modulation is carried out and the digitized voice data of M bitwise do not produce an isolated pit.

[0027] The record approach of the motion-picture film concerning the 2nd invention is characterized by carrying out two-dimensional record optically as N bit data of the two-dimensional array of $N=mxn$ which carries out the M-N modulation of the digitized voice data of M bitwise, and does not produce an isolated pit.

[0028] The record approach of the motion-picture film concerning the 3rd invention is characterized by carrying out two-dimensional record of the N bit data of two-dimensional array for the digitized voice data of M bitwise one by one at the longitudinal direction of a motion-picture film in the record approach of the motion-picture film concerning the 2nd invention.

[0029] The record approach of the motion-picture film concerning the 4th invention is characterized by assigning two or more kinds of N bit data for every unit to the digitized voice data of M bitwise, choosing N bit data with which the die length of the continuation pit where the same pit as the longitudinal direction of a motion-picture film continues becomes short for every unit, and carrying out two-dimensional record one by one in the record approach of the motion-picture film concerning the 3rd invention.

[0030] The record approach of the motion-picture film concerning the 5th invention is characterized by

assigning two kinds of reciprocal N bit data for every unit to the digitized voice data of M bitwise in the record approach of the motion-picture film concerning the 4th invention.

[0031]

[Function] In the motion-picture film concerning the 1st invention, digitized voice data do not produce an isolated pit on the digitized voice track by which two-dimensional record was carried out optically.

[0032] By the motion-picture film record approach concerning the 2nd invention, an isolated pit is not produced by carrying out two-dimensional record of the digitized voice data optically.

[0033] By the motion-picture film record approach concerning the 3rd invention, two-dimensional record of the digitized voice data is carried out one by one in the record approach of the motion-picture film concerning the 2nd invention at the longitudinal direction of a motion-picture film.

[0034] By the record approach of the motion-picture film concerning the 4th invention, the die length of the continuation pit where the same pit as the longitudinal direction of a motion-picture film continues is shortened in the record approach of the motion-picture film concerning the 3rd invention.

[0035] By the record approach of the motion-picture film concerning the 5th invention, the die length of the continuation pit where the same pit as the longitudinal direction of a motion-picture film continues is shortened by choosing two kinds of reciprocal N bit data for every unit.

[0036]

[Example] Hereafter, the motion-picture film concerning this invention and one example of the record approach of **** are explained to a detail with reference to a drawing. The motion-picture film concerning this invention is constituted as shown in drawing 1.

[0037] In drawing 1, 1 is a motion-picture film. To this motion-picture film 1 In order that a device may also enable audio playback the perforation section 3 for conveying a motion-picture film since it is the image recording field 2 and projection on which the image to project is recorded, and conventionally The analog voice track 4 with which optical recording of the prepared analog voice was given, and the digitized voice tracks 5 and 6 recorded on the outside of the perforation sections 3 and 3 established in right and left of a motion-picture film are formed.

[0038] In the above-mentioned digitized voice track 5 (6), two-dimensional record of the digitized voice data of 8 bitwises which digitized the analog sound signal is carried out as a $4 \times 3 = 12$ bit pit pattern which does not include an isolated pit by 8-12 modulation.

[0039] Thus, the pit pattern which does not include an isolated pit, i.e., the shortest repeat of one of every direction, is two or more pits. By carrying out two-dimensional record of the digitized voice data on the digitized voice track 5 of a motion-picture film 1 (6) as a pit pattern which is not surrounded in the four directions in every direction of all in the pit of other classes Since the pit of one of four directions becomes the same class, in the motion-picture film 1 concerning this invention It is hard coming to win popularity degradation resulting from degradation in the process like ****, i.e., the diffraction at the time of record, diffusion of the particle at the time of negative film development, dispersion between the degree of adhesion at the time of an imprint, and each class inside a film, diffusion of the particle at the time of positive film development, etc.

[0040] In addition, although the motion-picture film 1 of an above-mentioned example has the digitized voice track 5 (6) by which two-dimensional record was carried out as a $4 \times 3 = 12$ bit pit pattern from which the digitized voice data of 8 bitwises do not produce an isolated pit by eight to 12 modulation The motion-picture film concerning this invention is not what is limited only to this example. What is necessary is just to have the digitized voice track by which two-dimensional record was optically carried out as N bit data of the two-dimensional array of $N = m \times n$ with which a M-N modulation is carried out and the digitized voice data of M bitwise do not produce an isolated pit.

[0041] So, by the record approach of the motion-picture film concerning this invention, two-dimensional record is optically carried out as N bit data of the two-dimensional array of $N = m \times n$ which carries out the M-N modulation of the digitized voice data of M bitwise, and does not produce an isolated pit. The motion-picture film applied to this invention like **** which cannot receive degradation in a process easily by this can be created.

[0042] Here, the pit pattern of the two-dimensional array according to N bit data of a $N = m \times n$ bit when recording the digitized voice data of M bitwise as N bit data of the two-dimensional array of $N = m \times n$ is $2n \times 2m$. $2M$ which fulfill the regulation of not producing an isolated pit from this inside since there is a pattern of a

passage What is necessary is to find the pattern of an individual and just to assign the digitized voice data of the above-mentioned M bitwise. For example, as shown in A of drawing 2, when 1 byte, i.e., 8 bit data, is recorded as pit pattern { {a, b, c, d} of 4x3 arrays of a 12=4x triplet, {e, f, g, h}, and {i, j, k, and l}}, As what shows the condition of a pit that 0 is not exposed in the pit where 1 was exposed {Pit pattern { {1, 1, 1, 0}, {0, 0, 0, 1}, 0, 0, 1, and 1}} including the isolated pit d as shown in B of drawing 2 remove. {Pit pattern { {1, 1, 0, 0}, {0, 1, 1, 0}, 0, 0, 1, and 1}} which do not include an isolated pit as shown in C of drawing 2 are used.

[0043] In addition, although it is necessary to decide M-N modulation regulations also including the combination between ***** symbols to record more data bits M in the fewest possible channel bits N and a table becomes complicated, a table will become easy if it is made for each channel symbol to fulfill a M-N modulation regulation.

[0044] And what is necessary is just to perform it as follows, in order to investigate what fills with a mxn array the regulation of not producing an isolated pit.

[0045] That is, by the mxn array, it is 2n x2m. Since there is a pattern of a passage, this is expressed in procession of mxn, and when the condition of a pit that 0 is not exposed in the pit where 1 was exposed shall be shown, [101101000] 2 =360 are expressed in following procession T by 3x3 array, for example.

[0046]

[Equation 1]

$$\begin{vmatrix} 1 & 0 & 1 \\ 1 & 0 & 1 \\ 0 & 0 & 0 \end{vmatrix}$$

[0047] If coincidence with an vertical and horizontal element is investigated and there is at least one match about each element of this matrix, that element fulfills the modulation regulation. That is, in 3x3 arrays, it is

[0048], for example.

[Equation 2]

$$T = \begin{vmatrix} t_{11} & t_{12} & t_{13} \\ t_{21} & t_{22} & t_{23} \\ t_{31} & t_{32} & t_{33} \end{vmatrix},$$

$$A = \begin{vmatrix} 0 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{vmatrix}, \quad B = \begin{vmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{vmatrix}, \quad A' = \begin{vmatrix} 0 & 0 & 2 \\ 0 & 0 & 2 \\ 0 & 0 & 2 \end{vmatrix}, \quad B' = \begin{vmatrix} 2 & 0 & 0 \\ 2 & 0 & 0 \\ 2 & 0 & 0 \end{vmatrix},$$

$$A'' = \begin{vmatrix} 2 & 2 & 2 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{vmatrix}, \quad B'' = \begin{vmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 2 & 2 & 2 \end{vmatrix}, \quad I = \begin{vmatrix} 0 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{vmatrix}, \quad O = \begin{vmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{vmatrix}$$

[0049] It carries out and is [0050].

[Equation 3]

$$\{T(I-A) + A'\} * \{T(I-B) + B'\}$$

$$* \{T(I-A) + A''\} * \{T(I-B) + B''\} = O$$

[0051] It comes out, and if it is, Matrix T will fulfill a modulation regulation. Here, * expresses the product for every element of a matrix.

[0052] Each matrix element of T(I-A)+A' in the number 3 above-mentioned formula is [0053].

[Equation 4]

$$T(I - A) + A'$$

$$= \begin{vmatrix} t_{11} & t_{12} & t_{13} \\ t_{21} & t_{22} & t_{23} \\ t_{31} & t_{32} & t_{33} \end{vmatrix} \cdot \begin{vmatrix} 1 & 0 & 0 \\ -1 & 1 & 0 \\ 0 & -1 & 1 \end{vmatrix} + \begin{vmatrix} 0 & 0 & 2 \\ 0 & 0 & 2 \\ 0 & 0 & 2 \end{vmatrix}$$

$$= \begin{vmatrix} t_{11} - t_{12} & t_{12} - t_{13} & t_{13} + 2 \\ t_{21} - t_{22} & t_{22} - t_{23} & t_{23} + 2 \\ t_{31} - t_{32} & t_{32} - t_{33} & t_{33} + 2 \end{vmatrix}$$

[0054] It comes out. Moreover, each matrix element of $T(I-B)+B'$ is [0055].

[Equation 5]

$$T(I - B) + B'$$

$$= \begin{vmatrix} t_{11} & t_{12} & t_{13} \\ t_{21} & t_{22} & t_{23} \\ t_{31} & t_{32} & t_{33} \end{vmatrix} \cdot \begin{vmatrix} 1 & -1 & 0 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{vmatrix} + \begin{vmatrix} 2 & 0 & 0 \\ 2 & 0 & 0 \\ 2 & 0 & 0 \end{vmatrix}$$

$$= \begin{vmatrix} t_{11} + 2 & t_{12} - t_{11} & t_{13} - t_{12} \\ t_{21} + 2 & t_{22} - t_{21} & t_{23} - t_{22} \\ t_{31} + 2 & t_{32} - t_{31} & t_{33} - t_{32} \end{vmatrix}$$

[0056] It comes out. Moreover, each matrix element of $T(I-A)+A''$ is [0057].

[Equation 6]

$$T(I - A) + A''$$

$$= \begin{vmatrix} t_{11} & t_{12} & t_{13} \\ t_{21} & t_{22} & t_{23} \\ t_{31} & t_{32} & t_{33} \end{vmatrix} \cdot \begin{vmatrix} 1 & 0 & 0 \\ -1 & 1 & 0 \\ 0 & -1 & 1 \end{vmatrix} + \begin{vmatrix} 2 & 2 & 2 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{vmatrix}$$

$$= \begin{vmatrix} t_{11} + 2 & t_{12} + 2 & t_{13} + 2 \\ t_{21} - t_{11} & t_{22} - t_{12} & t_{23} - t_{13} \\ t_{31} - t_{21} & t_{32} - t_{22} & t_{33} - t_{23} \end{vmatrix}$$

[0058] It comes out. Moreover, each matrix element of $T(I-B)+B''$ is [0059].

[Equation 7]

$$T(I - B) + B''$$

$$= \begin{vmatrix} t_{11} & t_{12} & t_{13} \\ t_{21} & t_{22} & t_{23} \\ t_{31} & t_{32} & t_{33} \end{vmatrix} \cdot \begin{vmatrix} 1 & -1 & 0 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{vmatrix} + \begin{vmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 2 & 2 & 2 \end{vmatrix}$$

$$= \begin{vmatrix} t_{11} - t_{21} & t_{12} - t_{22} & t_{13} - t_{23} \\ t_{21} - t_{31} & t_{22} - t_{32} & t_{23} - t_{33} \\ t_{31} + 2 & t_{32} + 2 & t_{33} + 2 \end{vmatrix}$$

[0060] It comes out. Therefore, each matrix element of the left part in the number 3 above-mentioned formula is [0061].

[Equation 8]

$$\{T(I - A) + A'\} * \{T(I - B) + B'\}$$

$$* \{T(I - A) + A''\} * \{T(I - B) + B''\}$$

$$= \begin{vmatrix} (t_{11} - t_{12})(t_{11} + 2)(t_{11} + 2) & (t_{11} - t_{21})(t_{12} - t_{13}) \cdots (t_{13} + 2) \cdots \\ (t_{21} - t_{22})(t_{21} + 2)(t_{21} - t_{11})(t_{21} - t_{31}) & (t_{22} - t_{23}) \cdots (t_{23} + 2) \cdots \\ (t_{31} - t_{32})(t_{31} + 2)(t_{31} - t_{21})(t_{31} + 2) & (t_{32} - t_{33}) \cdots (t_{33} + 2) \cdots \end{vmatrix}$$

[0062] It becomes. If this is investigated from 0 to $2^m \times 2^n - 1$, the number of the pattern which can be used for a modulation, and an array is known.

[0063] The patterns which do not produce the isolated pit which can be used for a modulation in 3×3 arrays are 126 patterns, and have shown 63 patterns (the 63 remaining patterns are reverse patterns with which 1 and 0 were replaced.) of the one half of all the patterns in the following table 1 - a table 3.

[0064]

[A table 1]

{ { 1 , 0 , 0 } , { 1 , 0 , 0 } , { 0 , 0 , 0 } }
 { { 1 , 0 , 0 } , { 1 , 0 , 0 } , { 1 , 0 , 0 } }
 { { 1 , 0 , 0 } , { 1 , 0 , 0 } , { 1 , 1 , 0 } }
 { { 1 , 0 , 0 } , { 1 , 0 , 0 } , { 1 , 1 , 1 } }
 { { 1 , 0 , 0 } , { 1 , 0 , 1 } , { 0 , 0 , 1 } }
 { { 1 , 0 , 0 } , { 1 , 0 , 1 } , { 1 , 0 , 1 } }
 { { 1 , 0 , 0 } , { 1 , 0 , 1 } , { 1 , 1 , 1 } }
 { { 1 , 0 , 0 } , { 1 , 1 , 0 } , { 0 , 0 , 0 } }
 { { 1 , 0 , 0 } , { 1 , 1 , 0 } , { 1 , 0 , 0 } }
 { { 1 , 0 , 0 } , { 1 , 1 , 0 } , { 1 , 1 , 0 } }
 { { 1 , 0 , 0 } , { 1 , 1 , 0 } , { 1 , 1 , 1 } }
 { { 1 , 0 , 0 } , { 1 , 1 , 1 } , { 0 , 0 , 0 } }
 { { 1 , 0 , 0 } , { 1 , 1 , 1 } , { 0 , 0 , 1 } }
 { { 1 , 0 , 0 } , { 1 , 1 , 1 } , { 1 , 0 , 0 } }
 { { 1 , 0 , 0 } , { 1 , 1 , 1 } , { 1 , 1 , 1 } }
 { { 1 , 0 , 1 } , { 1 , 0 , 1 } , { 0 , 0 , 0 } }
 { { 1 , 0 , 1 } , { 1 , 0 , 1 } , { 0 , 0 , 1 } }
 { { 1 , 0 , 1 } , { 1 , 0 , 1 } , { 1 , 0 , 0 } }
 { { 1 , 0 , 1 } , { 1 , 0 , 1 } , { 1 , 0 , 1 } }
 { { 1 , 0 , 1 } , { 1 , 0 , 1 } , { 1 , 1 , 1 } }
 { { 1 , 1 , 0 } , { 0 , 0 , 0 } , { 0 , 0 , 0 } }

[0065]

[A table 2]

{ { 1, 1, 0 } , { 0, 0, 0 } , { 0, 1, 1 } }
 { { 1, 1, 0 } , { 0, 0, 0 } , { 1, 1, 0 } }
 { { 1, 1, 0 } , { 0, 0, 0 } , { 1, 1, 1 } }
 { { 1, 1, 0 } , { 0, 1, 0 } , { 0, 0, 0 } }
 { { 1, 1, 0 } , { 0, 1, 0 } , { 0, 1, 0 } }
 { { 1, 1, 0 } , { 0, 1, 0 } , { 0, 1, 1 } }
 { { 1, 1, 0 } , { 1, 0, 0 } , { 0, 0, 0 } }
 { { 1, 1, 0 } , { 1, 0, 0 } , { 1, 0, 0 } }
 { { 1, 1, 0 } , { 1, 0, 0 } , { 1, 1, 0 } }
 { { 1, 1, 0 } , { 1, 0, 0 } , { 1, 1, 1 } }
 { { 1, 1, 0 } , { 1, 1, 0 } , { 0, 0, 0 } }
 { { 1, 1, 0 } , { 1, 1, 0 } , { 1, 0, 0 } }
 { { 1, 1, 0 } , { 1, 1, 0 } , { 1, 1, 0 } }
 { { 1, 1, 0 } , { 1, 1, 0 } , { 1, 1, 1 } }
 { { 1, 1, 1 } , { 0, 0, 0 } , { 0, 0, 0 } }
 { { 1, 1, 1 } , { 0, 0, 0 } , { 0, 1, 1 } }
 { { 1, 1, 1 } , { 0, 0, 0 } , { 1, 1, 0 } }
 { { 1, 1, 1 } , { 0, 0, 0 } , { 1, 1, 1 } }
 { { 1, 1, 1 } , { 0, 0, 1 } , { 0, 0, 0 } }
 { { 1, 1, 1 } , { 0, 0, 1 } , { 0, 0, 1 } }
 { { 1, 1, 1 } , { 0, 0, 1 } , { 0, 1, 1 } }

[0066]

[A table 3]

{ { 1, 1, 1 } , { 0, 0, 1 } , { 1, 1, 1 } }
 { { 1, 1, 1 } , { 0, 1, 0 } , { 0, 0, 0 } }
 { { 1, 1, 1 } , { 0, 1, 0 } , { 0, 1, 0 } }
 { { 1, 1, 1 } , { 0, 1, 1 } , { 0, 0, 0 } }
 { { 1, 1, 1 } , { 0, 1, 1 } , { 0, 0, 1 } }
 { { 1, 1, 1 } , { 0, 1, 1 } , { 0, 1, 1 } }
 { { 1, 1, 1 } , { 1, 0, 0 } , { 0, 0, 0 } }
 { { 1, 1, 1 } , { 1, 0, 0 } , { 1, 0, 0 } }
 { { 1, 1, 1 } , { 1, 0, 0 } , { 1, 1, 0 } }
 { { 1, 1, 1 } , { 1, 0, 0 } , { 1, 1, 1 } }
 { { 1, 1, 1 } , { 1, 0, 1 } , { 0, 0, 0 } }
 { { 1, 1, 1 } , { 1, 0, 1 } , { 0, 0, 1 } }
 { { 1, 1, 1 } , { 1, 0, 1 } , { 1, 0, 0 } }
 { { 1, 1, 1 } , { 1, 0, 1 } , { 1, 0, 1 } }
 { { 1, 1, 1 } , { 1, 1, 0 } , { 0, 0, 0 } }
 { { 1, 1, 1 } , { 1, 1, 0 } , { 1, 0, 0 } }
 { { 1, 1, 1 } , { 1, 1, 0 } , { 1, 1, 0 } }
 { { 1, 1, 1 } , { 1, 1, 1 } , { 0, 0, 0 } }
 { { 1, 1, 1 } , { 1, 1, 1 } , { 0, 0, 1 } }
 { { 1, 1, 1 } , { 1, 1, 1 } , { 1, 0, 0 } }
 { { 1, 1, 1 } , { 1, 1, 1 } , { 1, 1, 1 } }

[0067] Therefore, in the nine-channel pit of 3x3, the voice data of six or less data bits can be recorded, without producing an isolated pit.

[0068] Moreover, the patterns which do not produce the isolated pit which can be used for a modulation in 2x5 arrays are 220 patterns, and have shown 110 patterns (the 110 remaining patterns are reverse patterns with which 1 and 0 were replaced.) of the one half of all the patterns in the following table 4 - a table 8.

[0069]

[A table 4]

$\{ \{1, 0\}, \{1, 0\}, \{0, 0\}, \{0, 0\}, \{0, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{0, 0\}, \{0, 0\}, \{1, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{0, 0\}, \{0, 1\}, \{0, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{0, 0\}, \{0, 1\}, \{1, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{0, 0\}, \{1, 0\}, \{1, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{0, 0\}, \{1, 0\}, \{1, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{0, 0\}, \{1, 1\}, \{0, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{0, 0\}, \{1, 1\}, \{1, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{0, 1\}, \{0, 1\}, \{0, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{0, 1\}, \{0, 1\}, \{0, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{0, 1\}, \{0, 1\}, \{1, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 0\}, \{0, 0\}, \{0, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 0\}, \{0, 0\}, \{1, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 0\}, \{0, 1\}, \{0, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 0\}, \{1, 0\}, \{0, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 0\}, \{1, 0\}, \{1, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 0\}, \{1, 0\}, \{1, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 0\}, \{1, 1\}, \{0, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 0\}, \{1, 1\}, \{1, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 1\}, \{0, 0\}, \{0, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 1\}, \{0, 0\}, \{1, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 1\}, \{0, 1\}, \{0, 0\} \}$

[0070]

[A table 5]

$\{ \{1, 0\}, \{1, 0\}, \{1, 1\}, \{0, 1\}, \{0, 1\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 1\}, \{1, 0\}, \{0, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 1\}, \{1, 0\}, \{1, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 1\}, \{1, 1\}, \{0, 0\} \}$
 $\{ \{1, 0\}, \{1, 0\}, \{1, 1\}, \{1, 1\}, \{1, 1\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 0\}, \{0, 0\}, \{0, 0\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 0\}, \{0, 0\}, \{1, 1\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 0\}, \{0, 1\}, \{0, 1\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 0\}, \{0, 1\}, \{1, 1\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 0\}, \{1, 0\}, \{1, 0\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 0\}, \{1, 0\}, \{1, 1\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 0\}, \{1, 1\}, \{0, 0\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 0\}, \{1, 1\}, \{1, 1\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 1\}, \{0, 1\}, \{0, 0\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 1\}, \{0, 1\}, \{0, 1\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 1\}, \{0, 1\}, \{1, 1\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 1\}, \{1, 1\}, \{0, 0\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 1\}, \{1, 1\}, \{1, 1\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{0, 1\}, \{1, 0\}, \{0, 0\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{1, 0\}, \{1, 0\}, \{1, 0\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{1, 0\}, \{1, 0\}, \{1, 1\} \}$
 $\{ \{1, 1\}, \{0, 0\}, \{1, 0\}, \{1, 1\}, \{0, 0\} \}$

[0071]

[A table 6]

$\{(1, 1), (0, 0), (1, 0), (1, 1), (1, 1)\}$
 $\{(1, 1), (0, 0), (1, 1), (0, 0), (0, 0)\}$
 $\{(1, 1), (0, 0), (1, 1), (0, 0), (1, 1)\}$
 $\{(1, 1), (0, 0), (1, 1), (0, 1), (0, 0)\}$
 $\{(1, 1), (0, 0), (1, 1), (0, 1), (0, 1)\}$
 $\{(1, 1), (0, 0), (1, 1), (1, 0), (0, 0)\}$
 $\{(1, 1), (0, 0), (1, 1), (1, 0), (1, 0)\}$
 $\{(1, 1), (0, 0), (1, 1), (1, 1), (0, 0)\}$
 $\{(1, 1), (0, 0), (1, 1), (1, 1), (1, 1)\}$
 $\{(1, 1), (0, 1), (0, 0), (0, 0), (0, 0)\}$
 $\{(1, 1), (0, 1), (0, 0), (0, 0), (1, 1)\}$
 $\{(1, 1), (0, 1), (0, 0), (0, 1), (0, 1)\}$
 $\{(1, 1), (0, 1), (0, 0), (0, 1), (1, 1)\}$
 $\{(1, 1), (0, 1), (0, 0), (1, 0), (1, 0)\}$
 $\{(1, 1), (0, 1), (0, 0), (1, 0), (1, 1)\}$
 $\{(1, 1), (0, 1), (0, 0), (1, 1), (0, 0)\}$
 $\{(1, 1), (0, 1), (0, 0), (1, 1), (1, 1)\}$
 $\{(1, 1), (0, 1), (0, 1), (0, 0), (0, 0)\}$
 $\{(1, 1), (0, 1), (0, 1), (0, 0), (1, 1)\}$
 $\{(1, 1), (0, 1), (0, 1), (0, 1), (0, 0)\}$
 $\{(1, 1), (0, 1), (0, 1), (0, 1), (0, 1)\}$
 $\{(1, 1), (0, 1), (0, 1), (0, 1), (1, 1)\}$

[0072]

[A table 7]

$\{(1, 1), (0, 1), (0, 1), (1, 0), (1, 0)\}$
 $\{(1, 1), (0, 1), (1, 0), (1, 1), (0, 0)\}$
 $\{(1, 1), (0, 1), (0, 1), (1, 1), (1, 1)\}$
 $\{(1, 1), (1, 1), (0, 0), (0, 0), (0, 0)\}$
 $\{(1, 1), (1, 0), (0, 0), (0, 0), (1, 1)\}$
 $\{(1, 1), (1, 0), (0, 0), (0, 1), (0, 1)\}$
 $\{(1, 1), (1, 0), (0, 0), (0, 1), (1, 1)\}$
 $\{(1, 1), (1, 0), (0, 0), (0, 1), (1, 0)\}$
 $\{(1, 1), (1, 0), (0, 0), (1, 0), (1, 1)\}$
 $\{(1, 1), (1, 0), (0, 0), (1, 1), (0, 0)\}$
 $\{(1, 1), (1, 0), (0, 0), (1, 1), (1, 1)\}$
 $\{(1, 1), (1, 0), (1, 0), (0, 0), (0, 0)\}$
 $\{(1, 1), (1, 0), (1, 0), (0, 0), (1, 1)\}$
 $\{(1, 1), (1, 0), (1, 0), (0, 1), (0, 1)\}$
 $\{(1, 1), (1, 0), (1, 0), (0, 1), (0, 0)\}$
 $\{(1, 1), (1, 0), (1, 0), (1, 0), (1, 0)\}$
 $\{(1, 1), (1, 0), (1, 0), (1, 0), (1, 1)\}$
 $\{(1, 1), (1, 0), (1, 0), (1, 1), (0, 0)\}$
 $\{(1, 1), (1, 0), (1, 0), (1, 1), (1, 1)\}$
 $\{(1, 1), (1, 1), (0, 0), (0, 0), (0, 0)\}$
 $\{(1, 1), (1, 1), (0, 0), (0, 0), (1, 1)\}$
 $\{(1, 1), (1, 1), (0, 0), (0, 1), (0, 1)\}$

[0073]

[A table 8]

{ { 1 , 1 } , { 1 , 1 } , { 0 , 0 } , { 0 , 1 } , { 1 , 1 } }
 { { 1 , 1 } , { 1 , 1 } , { 0 , 0 } , { 1 , 0 } , { 1 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 0 , 0 } , { 1 , 0 } , { 1 , 1 } }
 { { 1 , 1 } , { 1 , 1 } , { 0 , 0 } , { 1 , 1 } , { 0 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 0 , 0 } , { 1 , 1 } , { 1 , 1 } }
 { { 1 , 1 } , { 1 , 1 } , { 0 , 1 } , { 0 , 0 } , { 0 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 0 , 1 } , { 0 , 0 } , { 1 , 1 } }
 { { 1 , 1 } , { 1 , 1 } , { 0 , 1 } , { 0 , 1 } , { 0 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 0 , 1 } , { 0 , 1 } , { 0 , 1 } }
 { { 1 , 1 } , { 1 , 1 } , { 0 , 1 } , { 0 , 1 } , { 1 , 1 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 0 } , { 0 , 0 } , { 0 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 0 } , { 0 , 0 } , { 1 , 1 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 0 } , { 1 , 0 } , { 0 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 0 } , { 1 , 0 } , { 1 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 0 } , { 1 , 0 } , { 1 , 1 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 1 } , { 0 , 0 } , { 0 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 1 } , { 0 , 0 } , { 1 , 1 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 1 } , { 0 , 1 } , { 0 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 1 } , { 0 , 1 } , { 0 , 1 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 1 } , { 1 , 0 } , { 0 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 1 } , { 1 , 0 } , { 1 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 1 } , { 1 , 1 } , { 0 , 0 } }
 { { 1 , 1 } , { 1 , 1 } , { 1 , 1 } , { 1 , 1 } , { 1 , 1 } }

[0074] Therefore, in the nine-channel pit of 3x3, the voice data of seven or less data bits can be recorded, without producing an isolated pit.

[0075] Furthermore, the patterns which do not produce the isolated pit which can be used for a modulation in 3x4 arrays are 780 patterns, and have shown 390 patterns (the 390 remaining patterns are reverse patterns with which 1 and 0 were replaced.) of the one half of all the patterns in the following table 9 - a table 23.

[0076]

[A table 9]

$\{ \{1, 0, 0, 0\}, \{1, 0, 0, 0\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 0\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 0\}, \{1, 0, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 0\}, \{1, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 0\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 0\}, \{1, 1, 1, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 0\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 1\}, \{0, 0, 0, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 1\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 1\}, \{1, 0, 0, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 1\}, \{1, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 1\}, \{1, 1, 0, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 0, 1\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 0\}, \{0, 0, 1, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 0\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 0\}, \{1, 0, 1, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 0\}, \{1, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 0\}, \{1, 1, 1, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 0\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 1\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 1\}, \{0, 0, 0, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 1\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 1\}, \{1, 0, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 1\}, \{1, 0, 0, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 1\}, \{1, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 0, 1, 1\}, \{1, 1, 0, 0\} \}$

[0077]

[A table 10]

$\{ \{1, 0, 0, 0\}, \{1, 0, 1, 1\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 0, 0\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 0, 0\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 0, 0\}, \{1, 0, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 0, 0\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 0, 0\}, \{1, 1, 1, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 0, 0\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 0, 1\}, \{0, 0, 0, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 0, 1\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 0, 1\}, \{1, 0, 0, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 0, 1\}, \{1, 1, 0, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 0, 1\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 0\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 0\}, \{0, 0, 1, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 0\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 0\}, \{1, 0, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 0\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 0\}, \{1, 1, 1, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 0\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 1\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 1\}, \{0, 0, 0, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 1\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 1\}, \{1, 0, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 1\}, \{1, 0, 0, 1\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 1\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 0, 0, 0\}, \{1, 1, 1, 1\}, \{1, 1, 1, 1\} \}$

[0078]

[A table 11]

{ (1, 0, 0, 1), (1, 0, 0, 1), (0, 0, 0, 0) }
 { (1, 0, 0, 1), (1, 0, 0, 1), (0, 0, 0, 1) }
 { (1, 0, 0, 1), (1, 0, 0, 1), (0, 0, 1, 1) }
 { (1, 0, 0, 1), (1, 0, 0, 1), (1, 0, 0, 0) }
 { (1, 0, 0, 1), (1, 0, 0, 1), (1, 0, 0, 1) }
 { (1, 0, 0, 1), (1, 0, 0, 1), (1, 0, 1, 1) }
 { (1, 0, 0, 1), (1, 0, 0, 1), (1, 1, 0, 0) }
 { (1, 0, 0, 1), (1, 0, 0, 1), (1, 1, 0, 1) }
 { (1, 0, 0, 1), (1, 0, 0, 1), (1, 1, 1, 1) }
 { (1, 0, 0, 1), (1, 0, 1, 1), (0, 0, 0, 0) }
 { (1, 0, 0, 1), (1, 0, 1, 1), (0, 0, 0, 1) }
 { (1, 0, 0, 1), (1, 0, 1, 1), (0, 0, 1, 1) }
 { (1, 0, 0, 1), (1, 0, 1, 1), (1, 0, 0, 0) }
 { (1, 0, 0, 1), (1, 0, 1, 1), (1, 0, 0, 1) }
 { (1, 0, 0, 1), (1, 0, 1, 1), (1, 0, 1, 1) }
 { (1, 0, 0, 1), (1, 0, 1, 1), (1, 1, 0, 0) }
 { (1, 0, 0, 1), (1, 0, 1, 1), (1, 1, 1, 1) }
 { (1, 0, 0, 1), (1, 1, 0, 1), (0, 0, 0, 0) }
 { (1, 0, 0, 1), (1, 1, 0, 1), (0, 0, 0, 1) }
 { (1, 0, 0, 1), (1, 1, 0, 1), (0, 0, 1, 1) }
 { (1, 0, 0, 1), (1, 1, 0, 1), (1, 0, 0, 0) }
 { (1, 0, 0, 1), (1, 1, 0, 1), (1, 0, 0, 1) }
 { (1, 0, 0, 1), (1, 1, 0, 1), (1, 1, 0, 0) }
 { (1, 0, 0, 1), (1, 1, 0, 1), (1, 1, 0, 1) }
 { (1, 0, 0, 1), (1, 1, 0, 1), (1, 1, 1, 1) }
 { (1, 0, 0, 1), (1, 1, 1, 1), (0, 0, 0, 0) }

[0079]

[A table 12]

$\{ \{1, 0, 0, 1\}, \{1, 1, 1, 1\}, \{0, 0, 0, 1\} \}$
 $\{ \{1, 0, 0, 1\}, \{1, 1, 1, 1\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 0, 1\}, \{1, 1, 1, 1\}, \{1, 0, 0, 0\} \}$
 $\{ \{1, 0, 0, 1\}, \{1, 1, 1, 1\}, \{1, 0, 0, 1\} \}$
 $\{ \{1, 0, 0, 1\}, \{1, 1, 1, 1\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 0, 0, 1\}, \{1, 1, 1, 1\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 0, 1, 0\}, \{1, 0, 1, 0\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 0, 1, 0\}, \{1, 0, 1, 0\}, \{0, 0, 1, 0\} \}$
 $\{ \{1, 0, 1, 0\}, \{1, 0, 1, 0\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 1, 0\}, \{1, 0, 1, 0\}, \{1, 0, 0, 0\} \}$
 $\{ \{1, 0, 1, 0\}, \{1, 0, 1, 0\}, \{1, 0, 1, 0\} \}$
 $\{ \{1, 0, 1, 0\}, \{1, 0, 1, 0\}, \{1, 0, 1, 1\} \}$
 $\{ \{1, 0, 1, 0\}, \{1, 0, 1, 0\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 0, 1, 0\}, \{1, 0, 1, 0\}, \{1, 1, 1, 0\} \}$
 $\{ \{1, 0, 1, 0\}, \{1, 0, 1, 0\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 0, 1, 1\}, \{1, 0, 0, 0\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 0, 1, 1\}, \{1, 0, 0, 0\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 1, 1\}, \{1, 0, 0, 0\}, \{1, 0, 0, 0\} \}$
 $\{ \{1, 0, 1, 1\}, \{1, 0, 0, 0\}, \{1, 0, 1, 1\} \}$
 $\{ \{1, 0, 1, 1\}, \{1, 0, 0, 0\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 0, 1, 1\}, \{1, 0, 0, 0\}, \{1, 1, 1, 0\} \}$
 $\{ \{1, 0, 1, 1\}, \{1, 0, 0, 0\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 0, 1, 1\}, \{1, 0, 0, 1\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 0, 1, 1\}, \{1, 0, 0, 1\}, \{0, 0, 0, 1\} \}$
 $\{ \{1, 0, 1, 1\}, \{1, 0, 0, 1\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 0, 1, 1\}, \{1, 0, 0, 1\}, \{1, 0, 0, 0\} \}$

[0080]

[A table 13]

{ { 1, 0, 1, 1 } , { 1, 0, 0, 1 } , { 1, 0, 0, 1 } }
 { { 1, 0, 1, 1 } , { 1, 0, 0, 1 } , { 1, 0, 1, 1 } }
 { { 1, 0, 1, 1 } , { 1, 0, 0, 1 } , { 1, 1, 0, 0 } }
 { { 1, 0, 1, 1 } , { 1, 0, 0, 1 } , { 1, 1, 0, 1 } }
 { { 1, 0, 1, 1 } , { 1, 0, 0, 1 } , { 1, 1, 1, 1 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 0 } , { 0, 0, 0, 0 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 0 } , { 0, 0, 1, 0 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 0 } , { 1, 0, 0, 0 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 0 } , { 1, 0, 1, 0 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 0 } , { 1, 1, 0, 0 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 0 } , { 1, 1, 1, 0 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 1 } , { 0, 0, 0, 0 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 1 } , { 0, 0, 0, 1 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 1 } , { 0, 0, 1, 1 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 1 } , { 1, 0, 0, 0 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 1 } , { 1, 0, 0, 1 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 1 } , { 1, 0, 1, 1 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 1 } , { 1, 1, 0, 0 } }
 { { 1, 0, 1, 1 } , { 1, 0, 1, 1 } , { 1, 1, 1, 1 } }
 { { 1, 1, 0, 0 } , { 0, 0, 0, 0 } , { 0, 0, 0, 0 } }
 { { 1, 1, 0, 0 } , { 0, 0, 0, 0 } , { 0, 0, 1, 1 } }
 { { 1, 1, 0, 0 } , { 0, 0, 0, 0 } , { 0, 1, 1, 0 } }
 { { 1, 1, 0, 0 } , { 0, 0, 0, 0 } , { 0, 1, 1, 1 } }
 { { 1, 1, 0, 0 } , { 0, 0, 0, 0 } , { 1, 1, 0, 0 } }
 { { 1, 1, 0, 0 } , { 0, 0, 0, 0 } , { 1, 1, 1, 0 } }
 { { 1, 1, 0, 0 } , { 0, 0, 0, 0 } , { 1, 1, 1, 1 } }

[0081]

[A table 14]

{ {1, 1, 0, 0}, {0, 0, 0, 1}, {0, 0, 0, 1} }
 { {1, 1, 0, 0}, {0, 0, 0, 1}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {0, 0, 0, 1}, {0, 1, 1, 1} }
 { {1, 1, 0, 0}, {0, 0, 0, 1}, {1, 1, 0, 1} }
 { {1, 1, 0, 0}, {0, 0, 0, 1}, {1, 1, 1, 1} }
 { {1, 1, 0, 0}, {0, 0, 1, 0}, {0, 0, 1, 0} }
 { {1, 1, 0, 0}, {0, 0, 1, 0}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {0, 0, 1, 0}, {0, 1, 1, 0} }
 { {1, 1, 0, 0}, {0, 0, 1, 0}, {0, 1, 1, 1} }
 { {1, 1, 0, 0}, {0, 0, 1, 0}, {1, 1, 1, 0} }
 { {1, 1, 0, 0}, {0, 0, 1, 0}, {1, 1, 1, 1} }
 { {1, 1, 0, 0}, {0, 0, 1, 1}, {0, 0, 0, 0} }
 { {1, 1, 0, 0}, {0, 0, 1, 1}, {0, 0, 0, 1} }
 { {1, 1, 0, 0}, {0, 0, 1, 1}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {0, 0, 1, 1}, {0, 1, 1, 1} }
 { {1, 1, 0, 0}, {0, 0, 1, 1}, {1, 1, 0, 0} }
 { {1, 1, 0, 0}, {0, 0, 1, 1}, {1, 1, 1, 1} }
 { {1, 1, 0, 0}, {0, 1, 0, 0}, {0, 0, 0, 0} }
 { {1, 1, 0, 0}, {0, 1, 0, 0}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {0, 1, 0, 0}, {0, 1, 0, 0} }
 { {1, 1, 0, 0}, {0, 1, 0, 0}, {0, 1, 1, 0} }
 { {1, 1, 0, 0}, {0, 1, 0, 0}, {0, 1, 1, 1} }
 { {1, 1, 0, 0}, {0, 1, 0, 1}, {0, 0, 0, 1} }
 { {1, 1, 0, 0}, {0, 1, 0, 1}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {0, 1, 0, 1}, {0, 1, 0, 1} }
 { {1, 1, 0, 0}, {0, 1, 0, 1}, {0, 1, 1, 1} }

[0082]

[A table 15]

{ {1, 1, 0, 0}, {0, 1, 1, 0}, {0, 0, 0, 0} }
 { {1, 1, 0, 0}, {0, 1, 1, 0}, {0, 0, 1, 0} }
 { {1, 1, 0, 0}, {0, 1, 1, 0}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {0, 1, 1, 0}, {0, 1, 0, 0} }
 { {1, 1, 0, 0}, {0, 1, 1, 0}, {0, 1, 1, 0} }
 { {1, 1, 0, 0}, {0, 1, 1, 0}, {0, 1, 1, 1} }
 { {1, 1, 0, 0}, {0, 1, 1, 1}, {0, 0, 0, 0} }
 { {1, 1, 0, 0}, {0, 1, 1, 1}, {0, 0, 0, 1} }
 { {1, 1, 0, 0}, {0, 1, 1, 1}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {0, 1, 1, 1}, {0, 1, 0, 0} }
 { {1, 1, 0, 0}, {0, 1, 1, 1}, {0, 1, 1, 1} }
 { {1, 1, 0, 0}, {1, 0, 0, 0}, {0, 0, 0, 0} }
 { {1, 1, 0, 0}, {1, 0, 0, 0}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {1, 0, 0, 0}, {1, 0, 0, 0} }
 { {1, 1, 0, 0}, {1, 0, 0, 0}, {1, 0, 1, 1} }
 { {1, 1, 0, 0}, {1, 0, 0, 0}, {1, 1, 0, 0} }
 { {1, 1, 0, 0}, {1, 0, 0, 0}, {1, 1, 1, 0} }
 { {1, 1, 0, 0}, {1, 0, 0, 0}, {1, 1, 1, 1} }
 { {1, 1, 0, 0}, {1, 0, 0, 1}, {0, 0, 0, 1} }
 { {1, 1, 0, 0}, {1, 0, 0, 1}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {1, 0, 0, 1}, {1, 0, 0, 1} }
 { {1, 1, 0, 0}, {1, 0, 0, 1}, {1, 0, 1, 1} }
 { {1, 1, 0, 0}, {1, 0, 0, 1}, {1, 1, 0, 1} }
 { {1, 1, 0, 0}, {1, 0, 0, 1}, {1, 1, 1, 1} }
 { {1, 1, 0, 0}, {1, 0, 1, 0}, {0, 0, 1, 0} }
 { {1, 1, 0, 0}, {1, 0, 1, 0}, {0, 0, 1, 1} }

[0083]

[A table 16]

{ {1, 1, 0, 0}, {1, 0, 1, 0}, {1, 0, 1, 0} }
 { {1, 1, 0, 0}, {1, 0, 1, 0}, {1, 0, 1, 1} }
 { {1, 1, 0, 0}, {1, 0, 1, 1}, {0, 0, 0, 0} }
 { {1, 1, 0, 0}, {1, 0, 1, 1}, {0, 0, 0, 1} }
 { {1, 1, 0, 0}, {1, 0, 1, 1}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {1, 0, 1, 1}, {1, 0, 0, 0} }
 { {1, 1, 0, 0}, {1, 0, 1, 1}, {1, 0, 0, 1} }
 { {1, 1, 0, 0}, {1, 0, 1, 1}, {1, 0, 1, 1} }
 { {1, 1, 0, 0}, {1, 1, 0, 0}, {0, 0, 0, 0} }
 { {1, 1, 0, 0}, {1, 1, 0, 0}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {1, 1, 0, 0}, {1, 0, 0, 0} }
 { {1, 1, 0, 0}, {1, 1, 0, 0}, {1, 1, 0, 0} }
 { {1, 1, 0, 0}, {1, 1, 0, 0}, {1, 1, 1, 0} }
 { {1, 1, 0, 0}, {1, 1, 0, 0}, {1, 1, 1, 1} }
 { {1, 1, 0, 0}, {1, 1, 0, 1}, {0, 0, 0, 1} }
 { {1, 1, 0, 0}, {1, 1, 0, 1}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {1, 1, 0, 1}, {1, 0, 0, 1} }
 { {1, 1, 0, 0}, {1, 1, 0, 1}, {1, 1, 0, 1} }
 { {1, 1, 0, 0}, {1, 1, 0, 1}, {1, 1, 1, 1} }
 { {1, 1, 0, 0}, {1, 1, 1, 0}, {0, 0, 0, 0} }
 { {1, 1, 0, 0}, {1, 1, 1, 0}, {0, 0, 1, 0} }
 { {1, 1, 0, 0}, {1, 1, 1, 0}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {1, 1, 1, 0}, {1, 0, 0, 0} }
 { {1, 1, 0, 0}, {1, 1, 1, 0}, {1, 1, 0, 0} }
 { {1, 1, 0, 0}, {1, 1, 1, 0}, {1, 1, 1, 0} }
 { {1, 1, 0, 0}, {1, 1, 1, 0}, {1, 1, 1, 1} }

[0084]

[A table 17]

{ {1, 1, 0, 0}, {1, 1, 1, 1}, {0, 0, 0, 0} }
 { {1, 1, 0, 0}, {1, 1, 1, 1}, {0, 0, 0, 1} }
 { {1, 1, 0, 0}, {1, 1, 1, 1}, {0, 0, 1, 1} }
 { {1, 1, 0, 0}, {1, 1, 1, 1}, {1, 0, 0, 0} }
 { {1, 1, 0, 0}, {1, 1, 1, 1}, {1, 0, 0, 1} }
 { {1, 1, 0, 0}, {1, 1, 1, 1}, {1, 1, 0, 0} }
 { {1, 1, 0, 0}, {1, 1, 1, 1}, {1, 1, 1, 1} }
 { {1, 1, 0, 1}, {0, 0, 0, 1}, {0, 0, 0, 0} }
 { {1, 1, 0, 1}, {0, 0, 0, 1}, {0, 0, 0, 1} }
 { {1, 1, 0, 1}, {0, 0, 0, 1}, {0, 0, 1, 1} }
 { {1, 1, 0, 1}, {0, 0, 0, 1}, {0, 1, 1, 1} }
 { {1, 1, 0, 1}, {0, 0, 0, 1}, {1, 1, 0, 0} }
 { {1, 1, 0, 1}, {0, 0, 0, 1}, {1, 1, 0, 1} }
 { {1, 1, 0, 1}, {0, 0, 0, 1}, {1, 1, 1, 1} }
 { {1, 1, 0, 1}, {0, 1, 0, 1}, {0, 0, 0, 0} }
 { {1, 1, 0, 1}, {0, 1, 0, 1}, {0, 0, 0, 1} }
 { {1, 1, 0, 1}, {0, 1, 0, 1}, {0, 0, 1, 1} }
 { {1, 1, 0, 1}, {0, 1, 0, 1}, {0, 1, 0, 0} }
 { {1, 1, 0, 1}, {0, 1, 0, 1}, {0, 1, 0, 1} }
 { {1, 1, 0, 1}, {0, 1, 0, 1}, {0, 1, 1, 1} }
 { {1, 1, 0, 1}, {1, 0, 0, 1}, {0, 0, 0, 0} }
 { {1, 1, 0, 1}, {1, 0, 0, 1}, {0, 0, 0, 1} }
 { {1, 1, 0, 1}, {1, 0, 0, 1}, {0, 0, 1, 1} }
 { {1, 1, 0, 1}, {1, 0, 0, 1}, {1, 0, 0, 0} }
 { {1, 1, 0, 1}, {1, 0, 0, 1}, {1, 0, 0, 1} }
 { {1, 1, 0, 1}, {1, 0, 0, 1}, {1, 0, 1, 1} }

[0085]

[A table 18]

$\{ \{1, 1, 0, 1\}, \{1, 0, 0, 1\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 1, 0, 1\}, \{1, 0, 0, 1\}, \{1, 1, 0, 1\} \}$
 $\{ \{1, 1, 0, 1\}, \{1, 0, 0, 1\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 1, 0, 1\}, \{1, 1, 0, 1\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 1, 0, 1\}, \{1, 1, 0, 1\}, \{0, 0, 0, 1\} \}$
 $\{ \{1, 1, 0, 1\}, \{1, 1, 0, 1\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 1, 0, 1\}, \{1, 1, 0, 1\}, \{1, 0, 0, 0\} \}$
 $\{ \{1, 1, 0, 1\}, \{1, 1, 0, 1\}, \{1, 0, 0, 1\} \}$
 $\{ \{1, 1, 0, 1\}, \{1, 1, 0, 1\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 1, 0, 1\}, \{1, 1, 0, 1\}, \{1, 1, 0, 1\} \}$
 $\{ \{1, 1, 0, 1\}, \{1, 1, 0, 1\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 0, 0\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 0, 0\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 0, 0\}, \{0, 1, 1, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 0, 0\}, \{0, 1, 1, 1\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 0, 0\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 0, 0\}, \{1, 1, 1, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 0, 0\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 1, 0\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 1, 0\}, \{0, 0, 1, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 1, 0\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 1, 0\}, \{0, 1, 1, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 1, 0\}, \{0, 1, 1, 1\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 1, 0\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 1, 0\}, \{1, 1, 1, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{0, 0, 1, 0\}, \{1, 1, 1, 1\} \}$

[0086]

[A table 19]

{ {1, 1, 1, 0}, {0, 1, 0, 0}, {0, 0, 0, 0} }
 { {1, 1, 1, 0}, {0, 1, 0, 0}, {0, 0, 1, 1} }
 { {1, 1, 1, 0}, {0, 1, 0, 0}, {0, 1, 0, 0} }
 { {1, 1, 1, 0}, {0, 1, 0, 0}, {0, 1, 1, 0} }
 { {1, 1, 1, 0}, {0, 1, 0, 0}, {0, 1, 1, 1} }
 { {1, 1, 1, 0}, {0, 1, 1, 0}, {0, 0, 0, 0} }
 { {1, 1, 1, 0}, {0, 1, 1, 0}, {0, 0, 1, 0} }
 { {1, 1, 1, 0}, {0, 1, 1, 0}, {0, 0, 1, 1} }
 { {1, 1, 1, 0}, {0, 1, 1, 0}, {0, 1, 0, 0} }
 { {1, 1, 1, 0}, {0, 1, 1, 0}, {0, 1, 1, 0} }
 { {1, 1, 1, 0}, {0, 1, 1, 0}, {0, 1, 1, 1} }
 { {1, 1, 1, 0}, {1, 0, 0, 0}, {0, 0, 0, 0} }
 { {1, 1, 1, 0}, {1, 0, 0, 0}, {0, 0, 1, 1} }
 { {1, 1, 1, 0}, {1, 0, 0, 0}, {1, 0, 0, 0} }
 { {1, 1, 1, 0}, {1, 0, 0, 0}, {1, 0, 1, 1} }
 { {1, 1, 1, 0}, {1, 0, 0, 0}, {1, 1, 0, 0} }
 { {1, 1, 1, 0}, {1, 0, 0, 0}, {1, 1, 1, 0} }
 { {1, 1, 1, 0}, {1, 0, 0, 0}, {1, 1, 1, 1} }
 { {1, 1, 1, 0}, {1, 0, 1, 0}, {0, 0, 0, 0} }
 { {1, 1, 1, 0}, {1, 0, 1, 0}, {0, 0, 1, 0} }
 { {1, 1, 1, 0}, {1, 0, 1, 0}, {0, 0, 1, 1} }
 { {1, 1, 1, 0}, {1, 0, 1, 0}, {1, 0, 0, 0} }
 { {1, 1, 1, 0}, {1, 0, 1, 0}, {1, 0, 1, 0} }
 { {1, 1, 1, 0}, {1, 0, 1, 0}, {1, 0, 1, 1} }
 { {1, 1, 1, 0}, {1, 1, 0, 0}, {0, 0, 0, 0} }
 { {1, 1, 1, 0}, {1, 1, 0, 0}, {0, 0, 1, 1} }

[0087]

[A table 20]

$\{ \{1, 1, 1, 0\}, \{1, 1, 0, 0\}, \{1, 0, 0, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{1, 1, 0, 0\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{1, 1, 0, 0\}, \{1, 1, 1, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{1, 1, 0, 0\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 1, 1, 0\}, \{1, 1, 1, 0\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{1, 1, 1, 0\}, \{0, 0, 1, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{1, 1, 1, 0\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 1, 1, 0\}, \{1, 1, 1, 0\}, \{1, 0, 0, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{1, 1, 1, 0\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{1, 1, 1, 0\}, \{1, 1, 1, 0\} \}$
 $\{ \{1, 1, 1, 0\}, \{1, 1, 1, 0\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 0\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 0\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 0\}, \{0, 1, 1, 0\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 0\}, \{0, 1, 1, 1\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 0\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 0\}, \{1, 1, 1, 0\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 0\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 1\}, \{0, 0, 0, 0\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 1\}, \{0, 0, 0, 1\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 1\}, \{0, 0, 1, 1\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 1\}, \{0, 1, 1, 1\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 1\}, \{1, 1, 0, 0\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 1\}, \{1, 1, 0, 1\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 0, 1\}, \{1, 1, 1, 1\} \}$
 $\{ \{1, 1, 1, 1\}, \{0, 0, 1, 0\}, \{0, 0, 0, 0\} \}$

[0088]

[A table 21]

{ {1, 1, 1, 1}, {0, 0, 1, 0}, {0, 0, 1, 0} }
 { {1, 1, 1, 1}, {0, 0, 1, 0}, {0, 1, 1, 0} }
 { {1, 1, 1, 1}, {0, 0, 1, 0}, {1, 1, 0, 0} }
 { {1, 1, 1, 1}, {0, 0, 1, 0}, {1, 1, 1, 0} }
 { {1, 1, 1, 1}, {0, 0, 1, 1}, {0, 0, 0, 0} }
 { {1, 1, 1, 1}, {0, 0, 1, 1}, {0, 0, 0, 1} }
 { {1, 1, 1, 1}, {0, 0, 1, 1}, {0, 0, 1, 1} }
 { {1, 1, 1, 1}, {0, 0, 1, 1}, {0, 1, 1, 1} }
 { {1, 1, 1, 1}, {0, 0, 1, 1}, {1, 1, 0, 0} }
 { {1, 1, 1, 1}, {0, 0, 1, 1}, {1, 1, 1, 1} }
 { {1, 1, 1, 1}, {0, 1, 0, 0}, {0, 0, 0, 0} }
 { {1, 1, 1, 1}, {0, 1, 0, 0}, {0, 0, 1, 1} }
 { {1, 1, 1, 1}, {0, 1, 0, 0}, {0, 1, 0, 0} }
 { {1, 1, 1, 1}, {0, 1, 0, 0}, {0, 1, 1, 0} }
 { {1, 1, 1, 1}, {0, 1, 0, 0}, {0, 1, 1, 1} }
 { {1, 1, 1, 1}, {0, 1, 0, 1}, {0, 0, 0, 0} }
 { {1, 1, 1, 1}, {0, 1, 0, 1}, {0, 0, 0, 1} }
 { {1, 1, 1, 1}, {0, 1, 0, 1}, {0, 1, 0, 0} }
 { {1, 1, 1, 1}, {0, 1, 0, 1}, {0, 1, 0, 1} }
 { {1, 1, 1, 1}, {0, 1, 1, 0}, {0, 0, 0, 0} }
 { {1, 1, 1, 1}, {0, 1, 1, 0}, {0, 0, 1, 0} }
 { {1, 1, 1, 1}, {0, 1, 1, 0}, {0, 1, 0, 0} }
 { {1, 1, 1, 1}, {0, 1, 1, 0}, {0, 1, 1, 0} }
 { {1, 1, 1, 1}, {0, 1, 1, 1}, {0, 0, 0, 0} }
 { {1, 1, 1, 1}, {0, 1, 1, 1}, {0, 0, 0, 1} }
 { {1, 1, 1, 1}, {0, 1, 1, 1}, {0, 0, 1, 1} }

[0089]

[A table 22]

{ { 1, 1, 1, 1 } , { 0, 1, 1, 1 } , { 0, 1, 0, 0 } }
 { { 1, 1, 1, 1 } , { 0, 1, 1, 1 } , { 0, 1, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 0 } , { 0, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 0 } , { 0, 0, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 0 } , { 1, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 0 } , { 1, 0, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 0 } , { 1, 1, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 0 } , { 1, 1, 1, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 0 } , { 1, 1, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 1 } , { 0, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 1 } , { 0, 0, 0, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 1 } , { 0, 0, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 1 } , { 1, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 1 } , { 1, 0, 0, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 1 } , { 1, 0, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 1 } , { 1, 1, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 1 } , { 1, 1, 0, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 0, 1 } , { 1, 1, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 1, 0 } , { 0, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 1, 0 } , { 0, 0, 1, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 1, 0 } , { 1, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 1, 0 } , { 1, 0, 1, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 1, 1 } , { 0, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 0, 1, 1 } , { 0, 0, 0, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 1, 1 } , { 0, 0, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 1, 1 } , { 1, 0, 0, 0 } }

[0090]

[A table 23]

{ { 1, 1, 1, 1 } , { 1, 0, 1, 1 } , { 1, 0, 0, 1 } }
 { { 1, 1, 1, 1 } , { 1, 0, 1, 1 } , { 1, 0, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 0 } , { 0, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 0 } , { 0, 0, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 0 } , { 1, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 0 } , { 1, 1, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 0 } , { 1, 1, 1, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 0 } , { 1, 1, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 1 } , { 0, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 1 } , { 0, 0, 0, 1 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 1 } , { 1, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 1 } , { 1, 0, 0, 1 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 1 } , { 1, 1, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 0, 1 } , { 1, 1, 0, 1 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 0 } , { 0, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 0 } , { 0, 0, 1, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 0 } , { 1, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 0 } , { 1, 1, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 0 } , { 1, 1, 1, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 1 } , { 0, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 1 } , { 0, 0, 0, 1 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 1 } , { 0, 0, 1, 1 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 1 } , { 1, 0, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 1 } , { 1, 0, 0, 1 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 1 } , { 1, 1, 0, 0 } }
 { { 1, 1, 1, 1 } , { 1, 1, 1, 1 } , { 1, 1, 1, 1 } }

[0091] Therefore, in the 12-channel pit of 3x4, the voice data of eight or less data bits can be recorded, without producing an isolated pit.

[0092] What is necessary is just to use digitized voice data of 1 byte, i.e., 8 bitwises, for 256 of 780 patterns, choosing, in order to record optically, without producing an isolated pit.

[0093] And by the record approach of the motion-picture film concerning this invention, as 256 patterns and reverse pattern of the 390 patterns shown in the above-mentioned table 9 - a table 23 (256 patterns) are used, two kinds of 12 reciprocal bit data are assigned for every unit to digitized voice data of 1 byte, i.e., 8 bitwises.

[0094] the digitized voice data of the above-mentioned 8 bitwises -- the 12 above-mentioned bit data -- carrying out -- the longitudinal direction of a motion-picture film -- one by one -- two-dimensional record -- carrying out -- hitting -- the above -- the direction where the die length of the continuation pit where the same pit as the longitudinal direction of a motion-picture film continues becomes short is chosen and recorded for every unit from two kinds of 12 reciprocal bit data.

[0095] namely, as shown, for example in drawing 3, about {pit pattern { { 1, 1, 1, 1 } , { 1, 0, 0, 0 } , 0, 0, 1, and 1 } } which are recorded previously The line with which it counted from right-hand side among each of that line, and most many same color pits are located in a line is found. next, from { {pit pattern { { 0, 0, 1, 1 } by two kinds of 12 reciprocal bit data assigned to the digitized voice data to record, { 0, 0, 0, 0 } , 1, 0, 0, and 0 } } or { { 1, 1, 0, 0 } , { 1, 1, 1, 1 } , 0, 1, 1, and 1 } } The color of the longest continuation line pit { 1, 1, 1, 1 } of {pit pattern { { 1, 1, 1, 1 } , { 1, 0, 0, 0 } , 0, 0, 1, and 1 } } recorded previously and objection chooses {***** pit pattern { { 0, 0, 1, 1 } , { 0, 0, 0, 0 } , 1, 0, 0, and 0 } } . The same processing as the following is repeated successively, and sequential

record of the 12 bit data with which the die length of the continuation pit where the same pit as the longitudinal direction of a motion-picture film continues becomes short is carried out.

[0096] In this way Worst pattern {{0, 0, 0, and 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} {{1 at the time of recording, 1, 1, 1 As {{{}, {0, 0, 0, 0}, 0, 0, 0, and 0}}, {{0, 0, 0, 0}, {1, 1, 1, 1}, 0, 0, 0, and 0}}, {{0, 0, 0, 0}, {0, 0, 0, 0}, 1, 1, 1, and 1}} are shown in drawing 4 The longest repeat of the longitudinal direction of a motion-picture film serves as 12 pits.

[0097]

[Effect of the Invention] In the motion-picture film concerning the 1st invention, since digitized voice data do not include an isolated pit on the digitized voice track by which two-dimensional record was carried out optically, it is hard to receive degradation in the process resulting from the diffraction at the time of record, diffusion of the particle at the time of negative film development, dispersion between the degree of adhesion at the time of an imprint, and each class inside a film, diffusion of the particle at the time of positive film development, etc. Therefore, high density record can be performed, without degrading a signal to the limit of resolution of a film. Moreover, in recording the data pit of the same magnitude as the former, it extends the margin of development process control. Since a ***** record signal is improved, it can extend conventionally also about the margin of a regeneration system.

[0098] By the motion-picture film record approach concerning the 2nd invention, high density record can be performed to the limit of resolution of a film, without being hard to receive degradation in a process and degrading a signal, since an isolated pit is not produced by carrying out two-dimensional record of the digitized voice data optically.

[0099] By the motion-picture film record approach concerning the 3rd invention, digitized voice data can carry out two-dimensional record of the digitized voice data in the record approach of the motion-picture film concerning the 2nd invention excluding an isolated pit on the digitized voice track in alignment with the longitudinal direction of a motion-picture film by carrying out two-dimensional record one by one at the longitudinal direction of a motion-picture film.

[0100] By the record approach of the motion-picture film concerning the 4th invention, in the record approach of the motion-picture film concerning the 3rd invention, the die length of the continuation pit where the same pit as the longitudinal direction of a motion-picture film continues can be shortened, and the longest repeat can be regulated.

[0101] By the record approach of the motion-picture film concerning the 5th invention, by choosing two kinds of reciprocal N bit data for every unit, the die length of the continuation pit where the same pit as the longitudinal direction of a motion-picture film continues can be shortened, and the longest repeat can be regulated.

[Translation done.]